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(54) Motor vehicle transmission mechanism

(57) This invention relates to a motor vehicle with a transmission mechanism 3 comprising a torque converter A, an engine 2 and a gear mechanism 8. The gear mechanism is provided at its output with a bevel pinion 9a to drive a transmission shaft 6 and a driving axle 4 of the vehicle. The bevel pinion 9a is located between the gear mechanism and the torque converter. This arrangement facilitates disposition of the torque converter and gear mechanism parallel to the driving axle of the vehicle.

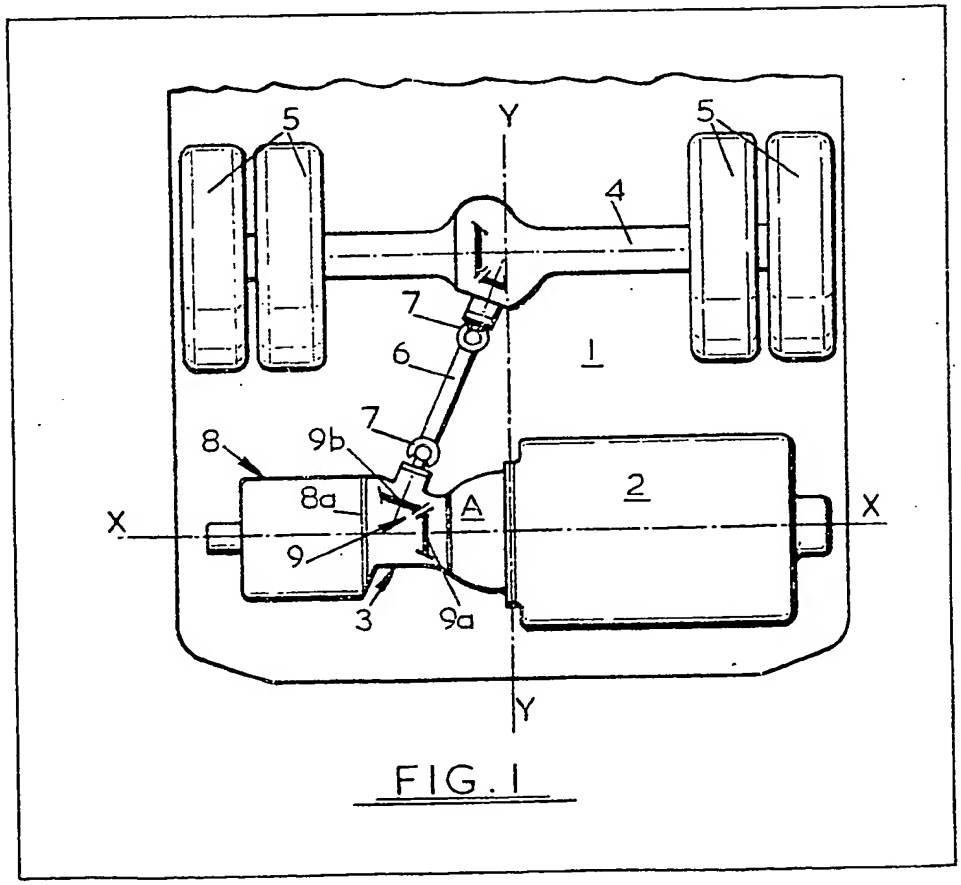

FIG. 1

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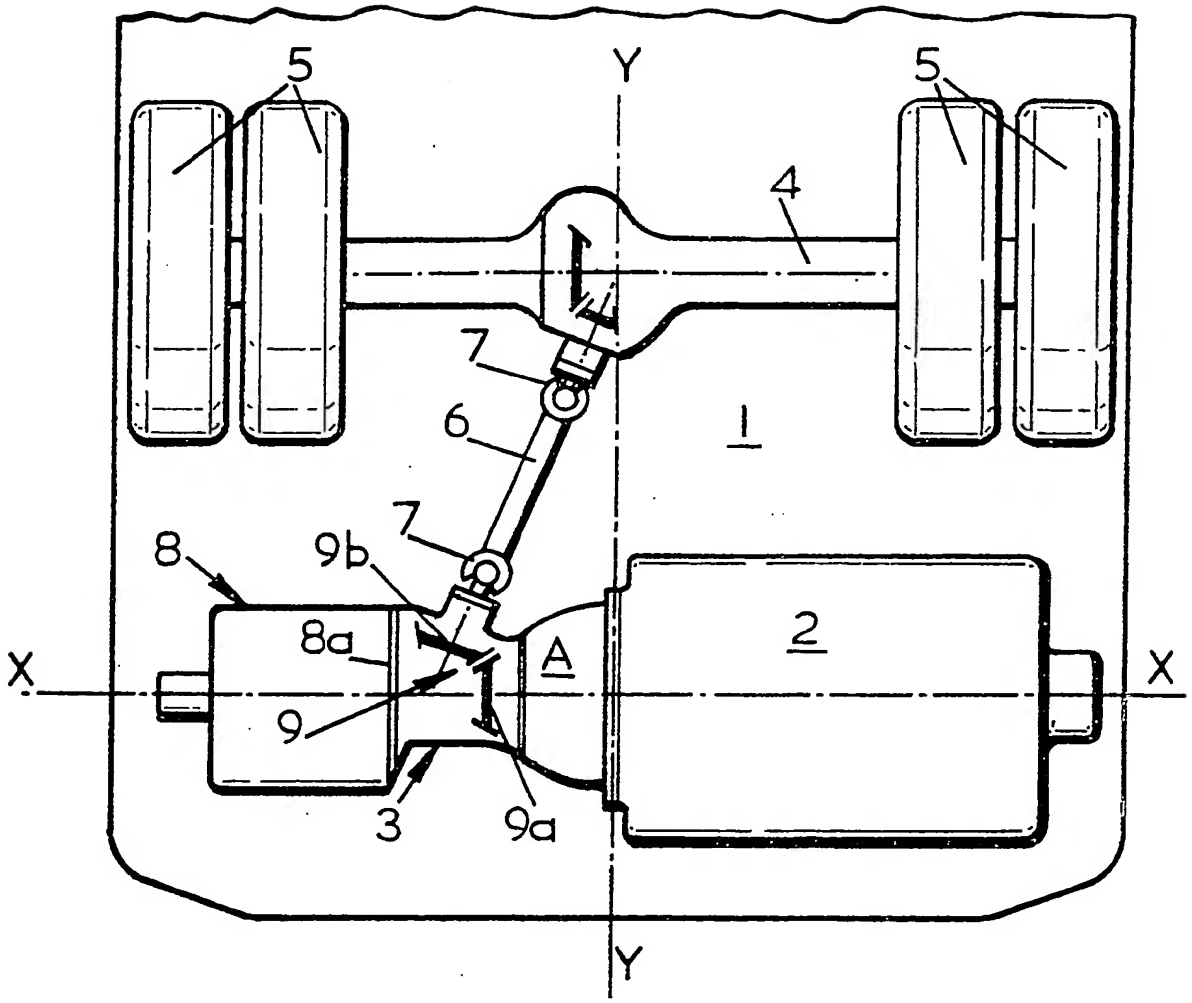

FIG. 1

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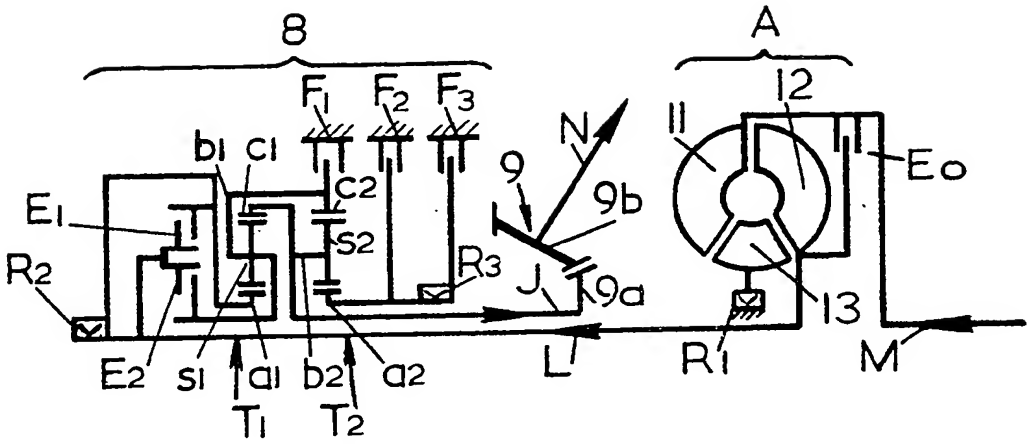

FIG. 2

GEARS	CLUTCHES		BRAKES		
	E1	E2	F1	F2	F3
1 ST				+	+
2 ND		+		+	+
3 RD	+	+		+	
NEUTRAL					
REVERSE			+		

FIG. 3

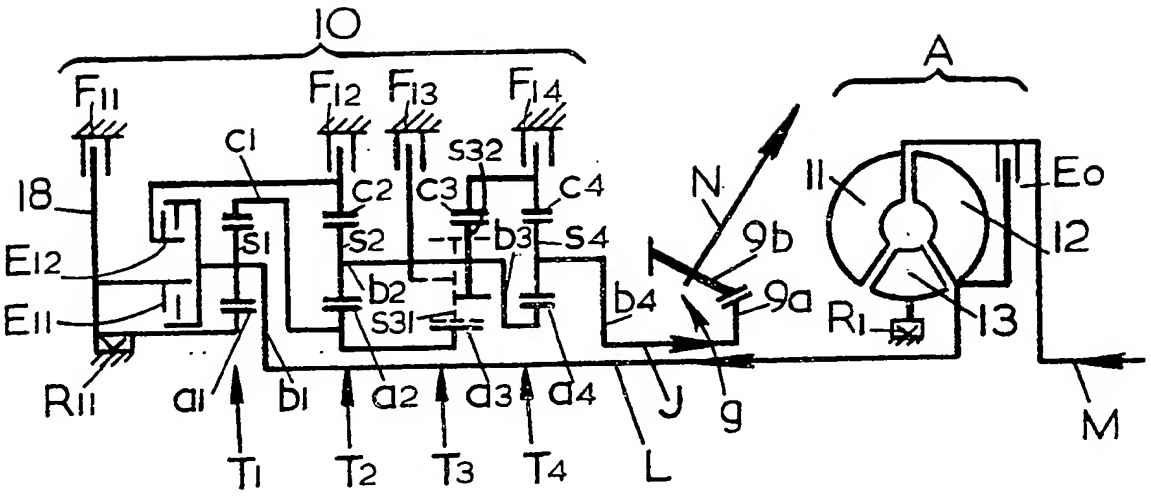

FIG. 4

GEARS	CLUTCHES		BRAKES			
	E11	E12	F11	F12	F13	F14
1ST	+				+	
2ND			+		+	
3RD	+			+		
4TH			+	+		
5TH	+	+				
6TH		+	+			
NEUTRAL	+					
REVERSE 1	+					+
REVERSE 2			+			+

FIG. 5

SPECIFICATION

A motor vehicle comprising a transmission mechanism

The present invention relates to a motor vehicle comprising a transmission mechanism and in particular to a motor vehicle for public transport.

The transmission mechanisms in question are change-speed gear mechanisms, commonly referred to as "gear-boxes", associated with a hydraulic torque converter.

In motor vehicles and in particular in motor coaches, it is known to place an engine, of the explosion type, as well as the transmission mechanism at the rear of the vehicle. Since the vehicle is driven by the back axle, the engine and transmission mechanism are located as close as possible to the back driving axle.

Various arrangements have been proposed for positioning the engine and transmission mechanism at the rear of the vehicle. In particular, it is known to place the engine at the rear of the driving axle and parallel to the latter. The transmission mechanism is located on an oblique axis and connected to the driving axle. In this case, for reasons of bulk, the output shaft of the engine drives the transmission mechanism by way of bevel gearing located between the converter and the gear-box. This arrangement, although advantageous, has numerous drawbacks and in particular the need to use special hydraulic torque converters. It is also necessary to change the direction of the blades of the converter from that normally used when the engine and transmission mechanism are located on the same axis.

On the other hand, this type of construction means that the transmission shaft comprising the universal joint which connects the output shaft of the gear-box and the driving axle is short, such that the universal joints undergo considerable and therefore dangerous angular deviations.

It is an object of the present invention to obviate or mitigate the above disadvantages.

According to the present invention there is provided a motor vehicle comprising a transmission mechanism including a torque converter having an input connected to an engine, and a change-speed gear mechanism which is located on the same axis as the converter and has an output shaft supporting a bevel pinion, the bevel pinion being located between the change-speed gear mechanism and the torque converter and connected to the driving axle of the vehicle, characterised in that the engine arrangement, the torque converter and the change-speed gear mechanism are arranged parallel to the driving axle of the vehicle.

Owing to this arrangement, the axis common to the torque converter and to the change-speed gear mechanism may be located parallel to the axle. A further feature of the invention resides in the fact that the engine, the torque converter and the change-speed gear mechanism face in the same direction, parallel to the driving axle of the vehicle and are preferably coaxial.

It is thus possible to locate the engine-converter-gear-box assembly transversely with respect to the vehicle.

An embodiment of the invention will now be described, by way of example only, with reference to the accompanying drawings in which;

Figure 1 is a diagrammatic view of the transmission mechanism according to the invention;

Figure 2 is a diagrammatic view of a transmission mechanism according to the invention, applied to a three-speed change-speed gear mechanism;

Figure 3 is a table indicating the engagement or disengagement of the various clutches and brakes for obtaining the various transmission ratios of the mechanism illustrated in Fig. 2;

Figure 4 is a diagrammatic view of the transmission mechanism according to the invention applied to a six-speed change-speed gear mechanism; and

Figure 5 is a table indicating the engagement or disengagement of the various clutches and brakes for obtaining the various transmission ratios of the mechanism illustrated in Fig. 4.

Referring to Fig. 1, the invention is applied to the drive of a vehicle of the motor-coach type, of which only the rear part 1 is shown. A mechanism for driving the rear wheels 5 supported by the axle 4 comprises an explosion engine 2, located at the rear of the axle 4 and whose axis X–X is perpendicular to the longitudinal axis Y–Y of the vehicle and is consequently parallel to the axle 4. The mechanism also comprises a transmission mechanism 3 connected to the engine 2 and located coaxially with the latter.

The axle 4 is connected to the transmission mechanism 3 by an oblique transmission shaft 6 comprising two universal joints 7.

The transmission mechanism is formed by a torque converter A which is located against the left-hand end (Fig. 1) of the engine 2 and by a gear-box 8 whose input shaft is connected to the converter A, and is coaxial therewith. The output shaft of the gear-box passes on the axis X–X through the right-hand side 8a of the latter, like the input shaft, and supports an output bevel pinion 9a of gearing 9. The gearing 9 is thus located between the converter A and the gear box 8. The pinion 9a is in mesh with an interacting bevel pinion 9b driving a transmission shaft 6.

The driving movement of the vehicle produced by the engine 2 is transmitted to the

rear wheels 5 of the vehicle successively by the torque converter A, the gear-box 8, the output gearing 9, the oblique transmission shaft 6 and the axle 4.

The transmission mechanism 3 and engine 2 are thus in alignment at the rear of the vehicle. It is thus easier to gain access to the engine and transmission mechanism for maintenance or repair. In motor-coaches particularly this arrangement reduces the bulk of this mechanism and thereby increases the accommodation space available in the vehicle.

This arrangement of the transmission mechanism and of the engine is possible owing to the particular construction of the transmission mechanism 3 in which the output gearing 9 of the gear-box 8 is located between the converter A and the gear-box 8. Thus the transmission shaft 6 may have an appropriate length while forming only a small angle with the line Y–Y.

In addition, this arrangement makes it possible for the output of the transmission mechanism 3, i.e. the output gearing 9, to be as close as possible to the longitudinal axis Y–Y of the vehicle, such that a considerable space is left around the wheels for suspension of the vehicle. This space is such that it makes it possible to provide a suspension for independent wheels.

Two embodiments of the transmission mechanism facilitating such an arrangement are shown diagrammatically, by way of example, in Figs. 2 to 4.

In the various figures, capital letters have been used to designate the transmission shafts of the mechanism and the main parts of this mechanism, such as the torque-converter A, clutches E_0, E_1, E_2, E_{11}, E_{12}, brakes F_1, F_2, F_3, F_{11}, F_{12}, F_{13}, F_{14} and free wheels R_1, R_2, R_3, R_{11}. Small letters have been used to designate epicyclic trains and numbers have been used to designate various other parts of the mechanism.

According to each of the embodiments, the torque is transmitted inside the gear-box 8 (Fig. 2) or 10 (Fig. 4), in a direction opposed to the direction in which it is introduced into the box from the converter A, such that the input and output shafts of the box, which are coaxial, are adjacent and outside the same end of the box.

According to the first embodiment illustrated in Figs. 2 and 3, the transmission mechanism according to the invention is intended to connect a driving shaft M to a driven shaft N, the driving shaft M being on the axis X–X and connected to the drive engine 2, whereas the driven shaft N is oblique with respect to the axis X–X and is connected to the transmission shaft 6.

As known, the torque converter A comprises a pump or impeller 11, a turbine 12 and a reactor 13. The pump 11 is a rotor connected to rotate with the driving shaft M and rotates the coaxial turbine 12 and reactor 13. As known, the free wheel R_1 connects the reactor 13 to a casing (not shown), and the clutch E_0 is interposed between the turbine 12 and the pump 11 in order to short-circuit or shunt the converter A, i.e. to render the latter inactive. A shaft L, coaxial with the shaft M, connects the turbine 12 of the converter to the input of the gear-box 8, located at the other end of the transmission mechanism 3.

The gear-box comprises an epicyclic train T_1 which comprises a planet wheel a_1 mounted on the shaft L, a toothed ring c_1 and a satellite-carrier b_1, carrying satellites s_1 which mesh with the planet wheel a_1 and the toothed rings c1. The planet wheel a_1 is connected to the shaft L by the free wheel R_2 and may be released or connected to rotate with the shaft L by the clutch E_1. The satellite-carrier b_1 may be released or connected to rotate with the shaft L by the clutch E_2 and may be released or prevented from rotating by the brake F_1. The ring c_1 is connected to an output shaft J also coaxial with the shaft M. The gear-box also comprises a second epicyclic train T_2 which comprises a planet wheel a_2, a satellite-carrier b_2, a ring c_2 and satellites s_2. The planet wheel a_2, which is mounted to rotate on the shaft J, may be released or prevented from rotating by the brake F_3 and connected to the free wheel R_3 which may be released or prevented from rotating by the brake F_2. The satellite-carrier b_2 is connected to the ring c_1 of the train T_1. The ring c_2 which is connected to the satellite-carrier b_1 of the train T_1 released or immobilised by the brake F_1.

The bevel pinion 9a of the output gearing 9 is integral with the output shaft J of the gear-box and the interacting bevel pinion 9b is integral with the driven shaft N of the transmission mechanism. The shaft N is connected to the transmission shaft 6 (Fig. 1).

The operation of the transmission mechanism will now be described. The transmission mechanism described makes it possible to obtain three forward speed ratios, a neutral position and a reverse speed ratio. Its operation will be described hereinafter with reference to Fig. 3, which is a table in the form of a grid whereof the rows correspond to the various transmission ratios and the columns to the brakes and clutches of the box. One compartment of the grid contains a plus sign if the corresponding clutch or brake is applied in the transmission ratio in question, the absence of a sign in a compartment on the other hand indicating that the corresponding clutch or brake is released. In all the cases considered, the driving shaft M is assumed to be rotated in the same direction by the engine 2.

As known, when the clutch E_0 is released, the hydraulic torque converter A transmits the rotary movement of the engine 2 to the shaft L, the free wheel R_1 releasing the reactor 13,

after starting of the vehicle, thus enabling it to rotate with the pump 11 and turbine 12.

Neutral

When all the clutches and brakes are released and the shaft L is rotated by the torque converter A, by means of the free wheel R_2, it rotates the planet wheel a_1 of the train T_1. Since no other actuating member is active, the movement entering the train T_1 is not passed-on and therefore not transmitted to the shaft J.

First gear

With respect to neutral, the modification which occurs is the application of the brakes F_2 and F_3, no other brake or clutch being applied.

The converter A drives the planet wheel a_1 of the train T_1 by means of the free wheel R_2. The brakes F_2 and F_3 are applied and the planet wheel a_2 of the train T_2 is blocked. Since the ring c_1 of the train T_1 is integral with the satellite-carrier b_2 of the train T_2, and the ring c_2 of the train T_2 is integral with the satellite-carrier b_1 of the train T_1, the satellite-carrier b_2 of the train T_2 and the shaft J are rotated. The shaft is thus able to rotate the shaft N by means of the output pinion 9a and the interacting pinion 9b.

Second gear

The change which occurs with respect to the first gear is the engagement of the clutch E_2. The engagement of the clutch E_2 causes the connection of the satellite-carrier b_1 of the train T_1 and of the ring c_2 of the train T_2. Since the engagement of the brake F_3 ensures immobilisation of the planet wheel a_2 of the train T_2 and the ring c_2, the train T_2 is set in rotation by the shaft L, by means of the clutch E_2. The satellite-carrier b_2, connected to the ring c_1 of the train T_2 and the shaft J integral with the ring c_1 are consequently rotated such that the movement is transmitted to the driven shaft N by the gearing 9.

Third gear

The change which occurs with respect to the second gear is the engagement of the clutch E_1 and the release of the brake F_3.

The engagement of the clutch E_1 causes the connection of the planet wheel a_1 to the shaft L and to the satellite-carrier b_1 of its train T_1. With the satellite- carrier b_1 and the planet wheel a_1 rotating at the same speed, since they are interconnected, the ring c_1 of the same train T_1 is also driven at the same speed. The output shaft J is driven at the speed of the input shaft L. A direct drive is thus established.

Reverse gear

Only the brake F_1 is applied, the clutches E_0, E_1, E_2 and the brakes F_2, F_3 are released. The converter rotates the planet wheel a_1 of the train T_1, by means of the free wheel R_2. The satellite-carrier b_1 is immo bilised by the brake F_1, and the ring c_1 rotates the shaft J in the reverse direction.

A gear box of this type, which is already known, may be used in a transmission mechanism according to the invention, since it is possible to locate the output gearing 9 between the converter A and the gear box 8.

According to another embodiment illustrated in Figs. 4 and 5, the transmission mechanism is formed as previously by a converter A, a gear box 10 and output gearing 9. Since the converter A and output gearing 9 are respectively identical to the converter and output gearing shown in Fig. 2 and aforedescribed, the same parts have the same names and the same reference numerals.

Only the gear box 10 is different from the gear box 8. This gear box 10 which makes it possible to obtain six forward speeds, neutral and two reverse speeds, conforms with the gear-box described in the Applicant's French Patent Application filed on September 29th 1976 under number 76 29508 and comprises four epicyclic trains T_1, T_2, T_3, T_4.

The planet wheel a_1 of the first train T_1 (a step-up gear) is connected to the turbine 12 and bears on the shaft L by means of the free wheel R_{11}. The satellite-carrier b_1 is connected to rotate with the shaft L and able to be connected in the manner described hereinafter either to the planet wheel a_1 of the same train, or to the ring c_2 of the train T_2 by the clutches E_{11} and E_{12} respectively.

The disc 18, integral with a_1, is able to be immobilised or locked by the brake F_{11}.

The ring c_1 is connected to the planet wheel a_2 of the train T_2, which is itself connected to the planet wheel a_3 of the train T_3. The ring c_2 of the train T_2 can be immobilised by a brake F_{12}.

The satellite-carrier b_2 of the train T_2 is common to that b_3 of the train T_3 and is able to be immobilised by a brake F_{13}. Furthermore, the satellite-carrier b_2, b_3 is connected to rotate with the planet wheel a_4 of the train T_4.

The train T_3, instead of being simple like T_1 and T_2, is complex, since it comprises meshing satellites s_{31} and s_{32} supported by the same support b_2, b_3, s_{31} meshes with a_3 and s_{32} meshes with c_3 as well as with s_{31} (shown in broken line behind c_{32}).

The ring c_3 rotates with the ring c_4 of the simple train T_4 and the two rings are able to be immobilised by the brake F_{14}.

Whereas the planet wheel a_4 rotates freely on the input shaft L, independently of the latter, the satellite-carrier b_4 is connected to rotate with the output shaft J which, by means of the bevel pinions 9a, 9b, is able to drive the oblique shaft N.

Operation (Figs. 4 and 5)

The table of Fig. 5 shows the state of activity (indicated by the plus sign) or non-activity (empty or blank compartment) of the various actuating members (brakes and clutches) for producing the various transmission ratios hereafter.

Neutral

The shaft L is driven by the torque converter A which is filled with oil under pressure. Since the clutch E_{11} is applied a_1 and b_1 are driven at the same speed, which is that of the shaft L and consequently, also c_1. The train T_1 thus operates by direct drive and transmits the movement to the following train by way of the ring c_1. Since none of the other actuating members of the following trains T_2 to T_4 is active and brakes F_{12} to F_{14} are also inactive, the movement entering the train T_2 is not transmitted further.

First gear (1)

With respect to neutral, the change which occurs is the application of the brake F_{13}, the clutch E_{11} still being applied.

In order that the movement is transmitted from one train to another, it is necessary that in each train, there is at least one driven member and one back-up member, the latter having to be either immobilised, or set in rotation itself.

These conditions are fulfilled for T_1 (a_1 and b_1 driven by L), for T_2 (a_2 driven and b_2 immobilised), for T_3 (a_3 driven and b_3 immobilised) and for T_4 (a_4 immobilised and b_4 driven). The planet wheel a_1 is driven by L due to the back-up provided by the free wheel R_{11} which puts the train T_1 in direct engage ment. In this case, the fuction of the clutch E_{11} is to prevent disengagement of the train T_1 and the shaft L when the vehicle could be driven quicker than the engine would allow, for example on a descent. The vehicle would in this case free-wheel. The engaged clutch E_{11} ensures complete engagement of the train T_1 with the input shaft L and consequently the engine holds back the vehicle (engine brake).

The movement thus passes from c_1 to a_2 and a_3 and from c_3 to c_4 and finally from c_4 to b_4 and, by way of the output shaft J, to the driven shaft N.

Second gear (2)

The change which occurs with respect to first gear is the disengagement of the clutch E_{11} and the application of the brake F_{11}, F_{13} remaining applied. The operation of the train T_1 is thus changed: a_1 is blocked by F_{11}; b_1 remains integral with the input shaft L by means of the free wheel R_{11}. The speed of c_1 is multiplied with respect to that of the shaft L.

The retention of a member for actuating the transmission mechanism such as F_{13}, in an active position, facilitates the passage from first gear to second gear without jerks. The free wheel R_{11} also contributes to this. It will be noted that the same is true when, for the other gear changes, an actuating member remains in the active position from one ratio to another.

Third gear (3)

As with first gear, the clutch E_{11} is engaged. As regards the brakes, it is the brake F_{12} which is applied.

Fourth gear (4)

F_{12} remains applied, whereas F_{11} is applied in turn and the two clutches are released or inactive.

Fifth gear (5)

The two clutches E_{11} and E_{12} are engaged. The result of this is that each train T_1, T_2, T_3, T_4 comprises two members rotating at the same speed as the driving shaft, such that each of the latter behaves as if it were prevented from rotating in direct engagement with the input shaft L. The transmission ratio between L and N is thus equal to 1 (direct engagement). Naturally, no brake is applied.

Sixth gear (6)

The brake F_{11} is once more applied. The clutch E_{12} is now engaged.

THE TWO REVERSE SPEED RATIOS

The latter are established in a manner similar to first and second gear, apart from the fact that the application of the brake F_{14} causes the satellite-carrier b_4 of the train T_4 to rotate more slowly and in the opposite direction.

With these various transmission ratios, it can be seen that the movement of the drive shaft L may enter by way of the first train T_1, or by the single satellite-carrier b_1, the planet wheel a_1 being blocked by the brake F_{11} and the train T_1 thus being a step-up train. Alternatively the movement of the drive shaft L may enter by way of the satellite-carrier b_1 and the planet wheel a_1 by means of the free wheel R_{11}, the train thus being in direct engagement with the driving shaft L.

Although the present invention has been described above with reference to two particular embodiments, it is not outside the scope of the invention to use any other variation of the transmission mechanism and in particular a gear-box of a type other than those described above.

CLAIMS

1. A motor vehicle comprising a transmission mechanism including a torque converter having an input connected to an engine, and a change-speed gear mechanism which is located on the same axis as the converter and

has an output shaft supporting a bevel pinion, the bevel pinion being located between the change-speed gear mechanism and the torque converter and connected to the driving axle of the vehicle, characterised in that the engine arrangement, the torque converter and the change-speed gear mechanism are arranged parallel to the driving axle of the vehicle.

2. A motor vehicle according to Claim 1, characterised in that the engine arrangement, the torque converter and the change-speed gear mechanism are coaxial.

3. A motor vehicle according to Claim 1 or 2, characterised in that the driving axle is the back axle of the vehicle.

4. A motor vehicle according to any one of Claims 1 to 3, characterised in that the output bevel gearing drives the axle by means of an oblique shaft which comprises universal joints.

5. A motor vehicle according to any one of Claims 1 to 4, in which the change-speed gear mechanism comprises epicyclic trains connected to each other, brakes and clutches being associated with the respective epicyclic trains, characterised in that the engine torque is transmitted inside the change-speed gear mechanism in a direction opposed to the direction in which it is introduced into this mechanism from the converter, such that input and output shafts of the mechanism, which are coaxial, are adjacent and outside the same end of the latter, and in that the epicyclic train, which follows the hydraulic torque converter and which is a first train is combined with two clutches whereof one is able to connect a member of the first train to the input shaft or to a further member of the first train and the other is able to connect a satellite-carrier of the first train to the input shaft or to a ring of a second train.

6. A motor vehicle according to Claim 5, characterised in that a free wheel is interposed between a planet wheel of the first train and the input shaft or the satellite-carrier of the first train.

7. A motor vehicle according to Claim 5 or 6, characterised in that some of the brakes are applied to toothed wheels and others to a member connected to rotate with part of the epicyclic train other than the ring.

8. A motor vehicle according to any one of Claims 5 to 7, characterised in that the output shaft is connected to rotate with a satellite-carrier of the last train.

9. A motor vehicle according to any one of Claims 5 to 8, characterised in that the first clutch of the first train is able to connect the planet wheel of the first train to the input shaft and the second clutch of the first train is able to connect the satellite-carrier of the first train to the input shaft, a ring of which first train being connected to the satellite-carrier of the second train and the output shaft.

10. A motor vehicle according to Claim 9, characterised in that the satellite-carrier of the first train which is connected to the ring of the second train may be immobilised by a brake.

11. A motor vehicle according to Claim 9 or 10, characterised in that a planet wheel of the second train, which is mounted to pivot on the output shaft may be released or prevented from rotating by a brake and connected to a free wheel which may be released or prevented from rotating by a further brake.

12. A motor vehicle according to any one of Claims 5 to 8, in which the change-speed gear mechanism comprises four epicyclic trains, characterised in that the first clutch is able to connect the satellite-carrier of the first train to another member of the first train and the second clutch is able to connect the satellite-carrier of the first train to the ring of the second train.

13. A motor vehicle according to Claim 12, characterised in that the intermediate epicyclic trains, located between the input train and the output train, comprise two members connected to rotate.

14. A motor vehicle according to Claim 13, characterised in that the intermediate trains have a common satellite-carrier.

15. A motor vehicle according to any one of Claims 12 to 14, characterised in that one intermediate train comprises two sets of satellites meshing with each other, a set of satellites meshing with the planet wheel and with the other set of satellites, whereas the other set of satellites meshes with the first set of satellites and with the ring.

16. A motor vehicle comprising a transmission mechanism according to any one of Claims 12 to 15, characterised in that the number of clutches and brakes is equal to the number of forward speed transmission ratios, whereas there are two reverse speed transmission ratios.

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